9 Evapotranspiration

9.1 General Description

Montana's low relative humidity, high percentage of sunshine, and high persistent winds contribute to a climate that is considered semiarid. Annually, evaporation ranges from 30 to about 50 inches. Evaporation varies much less on a yearly basis than either streamflow or precipitation. Extreme variations in annual total evaporation are within 25 percent of the long term annual average. However, at Montana's highest elevations, precipitation actually exceeds evaporation. To illustrate this point further, if a desert is simply defined as the net annual deficit of precipitation from evaporation, then the amount of precipitation in and of itself cannot determine if a region is a desert.

Most of Montana has been subjected to erosion for tens of thousands of years and less than 10 percent is covered with a mantle of recent (geologically speaking) water-transported soil. The lack of such soil and adequate moisture limits the natural vegetation to hardy plants such as sagebrush, greasewood, and short grass. Low relative humidity and a high rate of evaporation add to the problem. A number of abandoned homesteads of one time enthusiastic settlers bear silent testimony to the lack of moisture. Even so, dryland farming is carried on successfully in some areas.

9.2 Evapotranspiration

Due to needs for irrigation across much of Montana, evapotranspiration is a highly sought value.. This should come as no surprise since the agricultural community has a critical need to know the planting success rate of their crops that depend on available soil moisture. With evaporation exceeding precipitation by at least four times, irrigation water management becomes the best means to maximize productivity. Understanding plant root zone depths, soil types, and volume of irrigated water to apply, the ET or consumptive use of water by plants can then be more efficiently derived.

From field tests, about 40 percent of the total moisture intake by plants is extracted by the plant's roots from zero- to six-inch depths; 30 percent from six- to 12-inches; 20 percent from 12 to 18 inches; and 10 percent from 18 to 24 inches. Each soil type has an inherent "available water" holding capacity which can vary from 1.0 inch per acre foot for a loamy sand to 2.5 inches for a silty clay loam. Consequently, a two-foot root zone will typically have an irrigation water requirement that can vary between 1.5 inches (40,500 gallons per acre) for a course textured soil to 2.5 inches (67,500 gallons per acre) for a fine-textured soil. Most flood irrigation systems are between 45 to 70 percent efficient, therefore 3.0 inches (81,000 gallons per acre) is a recommended application.

It takes about 48 hours for the surface moisture to recharge the soil to a 24-inch depth for most soils. As a general guideline, a fully mature tree at peak water consumption can

remove 0.2 to 0.3 inches of moisture per acre per day. This translates to irrigating between eight and 10 days if no precipitation occurs during this interval. Of course solar radiation, wind, humidity, temperature, precipitation, crop variety, soil drainage, and water quality are important factors for successful irrigation.

Table 9.A. Annual average evapotranspiration (inches) for various stations across Montana

STN	ANN
Big Flat – Turner	50.43
Broken O Ranch	44.49
Bozeman	48.47
Dillon	49.45
Blackfeet	54.00
Teton River	49.73
Toston	48.00
Helena Valley	45.21
Malta	51.76
Moccasin	56.98
Greenfields	49.13
Jefferson Valley	54.29
Lower Musselshell	52.98
Ruby Valley	49.08
Shields Valley	47.42
Upper Musselshell	57.89
White Sulphur	47.59
Deer Lodge	46.48
Harlem	48.20